# DEVELOPMENT OF ROUND DIE FOR PRESS BRAKE MACHINE


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# SUPERVISOR DECLARATION

"I hereby declare that i have read this project report and in my opinion this project report is sufficient in terms of scope and quality for the award of the Diploma Mechanical of Engineering".

**Signature** :

**Supervisor** : DR. AHMAD RAZLAN BIN YUSUFF

**Date** :

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KHAIRUL SYAHMI BIN AHMAD

A report submitted in fulfilment of the

requirement for the award of the Diploma

of Mechanical Engineering

Faculty of Mechanical Engineering

University Malaysia Pahang

JANUARY 2012

# DECLARATION

I declare that this report entitled “Development o Round Die for Press Brake machine” is the result of my own research except as cited in the references. The report has not been accepted for any diploma and is not concurrently submitted in candidature of any other diploma.

**Signature** :

**Name** : Khairul Syahmi Bin Ahmad

**Date** :

# DEDICATION

First of all I would like to show my expression of gratitude to Allah for the guidance and grace so that can I finish this report. This dedication also goes to my beloved family which is my late father Hj Ahmad bin Ramli and my mother Puan Rosnah bt Othman. Special thanks also to all my friends that always support and encouragement toward this project. Thanks to all for your enduring patience, unfailing support and continuous encouragement.

## ACKNOWLEDGEMENT

I would like to express my gratitude and appreciation to all those who gave me the possibility to complete this report. Special thanks is due to my supervisor Dr. Ahmad Razlan bin Yusoff and co-supervisor En. Hazami bin Che Hussain whose help, stimulating suggestions and encouragement helped me in all time of fabrication process and in writing this report. I also would like to acknowledge with much appreciation the crucial role of the staff in Mechanical Laboratory, who gave me a permission to use the equipment, the machine and all the necessary tools in the laboratory.

Special thanks to Puan Imrah binti Yusuf against as the Final Year Coordinator, who has gave some idea, advices and also make sure the Final Year Project running properly.

Also a lot of thanks go to the lecturer especially to Mr. Fairusham bin Ghazali and Instructor Engineer Mr. Aziha, Mr. Khairul, Mr. Asmizam and also to all the supervisors who have gave their full effort in guiding me and in achieving the goal as well as their encouragement to maintain my progress work. And last but not list, with some respect I would like give a lot of appreciation to my partner, Mohd Naim bin Hasan, for spending his time, energy and the ideas to make this Final Year Project becomes realize.

## ABSTRACT

The target of this project was to design and fabricate the round die with radius 10mm. To success this project, the important things is to design the round die via Solidwork. After that, the mild steel materials were used in fabricate process based on cutting, milling, and edm wire cut. The results show the parts can be combined with the machine.

# ABSTRAK

Target projek ini adalah untuk merekea bentuk dan membuat die berbentuk separuh bulat berdiameter 10mm. Untuk menjayakan projek ini,perkara utama yang perlu diketahui ialah mengenai melukis die separuh bulat menggunakan solidwork. Perkara seterusnya ialah material besi digunakan untuk membuat proses berdasarkan pemotongan dan pengisaran. Keputusan dapat dilihat apabila die tersebut boleh di gabungkan dengan mesin.

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## 1.1 BACKGROUND

Nowadays, lots of integrated modular products are built in variant of function and shapes. These products are being used in many sectors in industry. The product being use to make a curve on the sheet metal. Since quality is a basic requirement for the design, providing clear manufacturability specifications and proper quality product is important. The designer is must have the feedback from consumers of creating the ideas of making their integrated modular product.

The design should have good performance in order to have zero problems while using their products. In related to have the quality of the product, making the integrated modular product design is also being focused on reducing the cost. This is the main perception from the customers if they want to buy the current product. This project will give more information background about the round dies. One example of the product that using this round die to be produce is coin.

In addition to producing two books, they also penned a nice feature article for the May 2005 issue of Numismatist ("The Saga of the 1870-S Silver Dollar"). In this article the authors quoted a letter from Carson City Mint Superintendent Abraham Curry to his colleague in San Francisco, Superintendent Oscar H. LaGrange, in which Curry made reference to "silver-dollar radius plates." The authors stated that the research had failed to turn up an explanation of this term. Since it have encountered the word "radius" in reference to die preparation on a few occasions, the first impulse was to contact the authors or draft a letter to the editor, but then it seemed that a more thorough look at the subject might be in order.

Published references to round die are actually quite rare. The term has never been, to the knowledge, explained in detail. Instead, what have found are passing references, such as those found . Usually, these turn up in the writings of U. S. Mint Chief Engraver Charles Barber (in office 1879-1917) or, less often, those of his successor, George T. Morgan (1917-25). More must be inferred from their indirect usage of the term than is actually stated. The closest thing that found in print to an actual explanation of die radius is a brief. Though not detailed, a person already familiar with the die-preparation process should be able to make a fairly good interpretation.

In short, round die refers to the curvature of the die face. Early United States coins typically had flat fields as a consequence of the primitive method of die preparation. Starting with the Christian Gobrecht designs of (1836-40), USA coinage began to reveal a slight concavity to the fields, though this isn't always apparent on casual inspection. Concave fields were the result of convex die faces, and this slight curvature had to be applied in a step that was separate from the actual sinking of the die. A working die that was ready for polishing was set into a jig with its face upward. The face of the die was then brought into contact with a polishing disc, or plate, that had a very shallow concavity to it. When spun against the face of the die, the disc imparted the same curvature profile, but the result was convex.

The purpose for giving the die face a slight curvature was to facilitate the movement of metal during the coin striking process. Experimentation with different degrees of curvature would ultimately determine the best standard for filling the dies in a single blow from the press. These experiments were carried out at the Philadelphia Mint's Engraving Department with all new designs starting at least as early as the Morgan dollar coinage of 1878 and possibly earlier. The difficulty that the Mint experienced in producing a satisfactory number of coins from each die pair with this coin type's original, high-relief obverse and its eight-tailfeather reverse demonstrated the need for such trial and error before working dies were shipped to all the branch mints.

Once the optimum die radius was determined , duplicate radius plates having this ideal curvature were sent along with the working dies to each of the other mints, so that the process could be repeated on-site. It was necessary that the various mints finished their dies locally, because the dies were sent from Philadelphia in an unhardened state (hardened dies, if intercepted in shipment, could more easily be used by counterfeiters).

If all went according to plan, the coins struck by each mint would be identical throughout in their degree of definition. But, as any collector of uncirculated Morgan dollars can attest, the sharpness of these coins varied considerably. This variance occurred in a characteristic manner from one mint to another. For example, New Orleans Mint Morgan dollars typically are soft at the centers and have strong edge reeding, while those coined at Philadelphia have sharp central details and mushy reeding. One can actually feel this difference by handling the coins' edges. Clearly, the movement of metal was being directed in accordance with differences in round die. The creation of radius plates went hand in hand with the practice of "basining," which I've described in previous columns. Basining was the process of giving dies their face polish when being used for the first time. In fact, the term "basin" often was used interchangeably by Mint employees to describe the face curvature, or radius. Polishing of a die performed after its initial use to repair flaws or to extend its useful life is not properly called basining, since the work was crude and, it may be assumed, was done without a radius plate.
The new, sculpted designs submitted by outside artists beginning in 1907 gradually rendered both radius plates and basining obsolete. The models as submitted already included the desired curvature, though the Mint's own staff sometimes had to modify

this radius in the hub reduction stage. Spring back will occur and must be compensated for when a radius exceeds four times thickness of material being formed. As the round die increase more over bend must be made to get the proper formed radius. Radius die sets typical fitted for one gauge and type of material. (Refer to the figure 1.1)

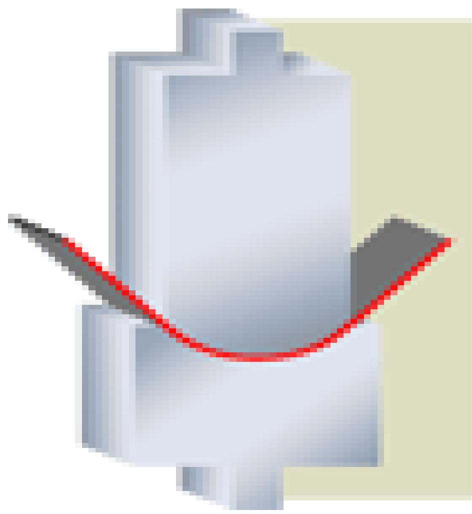

**Figure 1.1: Sets of die**

## 1.2 PROJECT OBJECTIVE

The objective of the project are:

- to design a round die for press brake machine
- to fabricate a round die using conventional milling machine and edm wirecut machine

## 1.3 PROJECT SCOPE OF WORK

There are two scope for this project which is drawing and fabricate.

**Draw**

Draw the design of the dies using solidworks software according specific machine dimension.

**Fabricate**

The project needed is to fabricate each part, in order to fabricate each part, the important thing is the dimension of each part must accurate. It's to avoid a problem in the assembly process.

## 1.4 PROJECT PLANNING

This project is begun with made a research and literature review via internet, books, supervisor, and others relevant academic material that related to my title, this literature review takes about a week. The reviews not stop there. It continues along the way of this project because knowledge is so many to learn. At the same week, do some schedule management for this project which included schedule management. This is done using Microsoft Office Project using Gantt chart system. This also takes a week to accomplish. The next week is submit the project title acceptance form and continue detail research in dimension of surface gauge. It also takes a week to be done. Sketch the general base shape of round die. Study how to develop the round die using press brake machine. Make a proposal for my project. It consist a chapter one that have background project, the introduction, objective and scope of work. The proposal is done using Microsoft Word. It takes a week to accomplish. (refer figure 1.2)

The next task is preparation of design and drawing using SolidWork software. This task is need skill using that software. In order to complete the design and drawing is need support from senior and friends. It can help me in using SolidWork Software in designing a difficult part. It takes a week to complete. For the next week, need to make a correction with the design and submit again. The correction takes 2 week to accomplish. The next week task is print out and submit the drawing. In the same week also have a discuss about the fabrication process. One week before the mid term, have done prepare for the first presentation. And for the next week, all the student final year that take the Project Last Year must present their project.

The fabrication process is schedule to takes after the mid term. It start from finding and cut the raw materials. Process in using conversional edm and milling machine. The process is scheduled to take part about three weeks. Next come the assembly, correction and finishing (refer to figure 1.3). This task scheduled to take time about three weeks.  Next task is the final report writing and final presentation preparation. This take about one week to accomplished. The report is guided by UMP Thesis writing guided and also the guidance of my supervisor. Due to all problems we had when doing the project the management has agreed to extend the time to submit the report and the presentation. All the task is scheduled to take about fourteen weeks overall.

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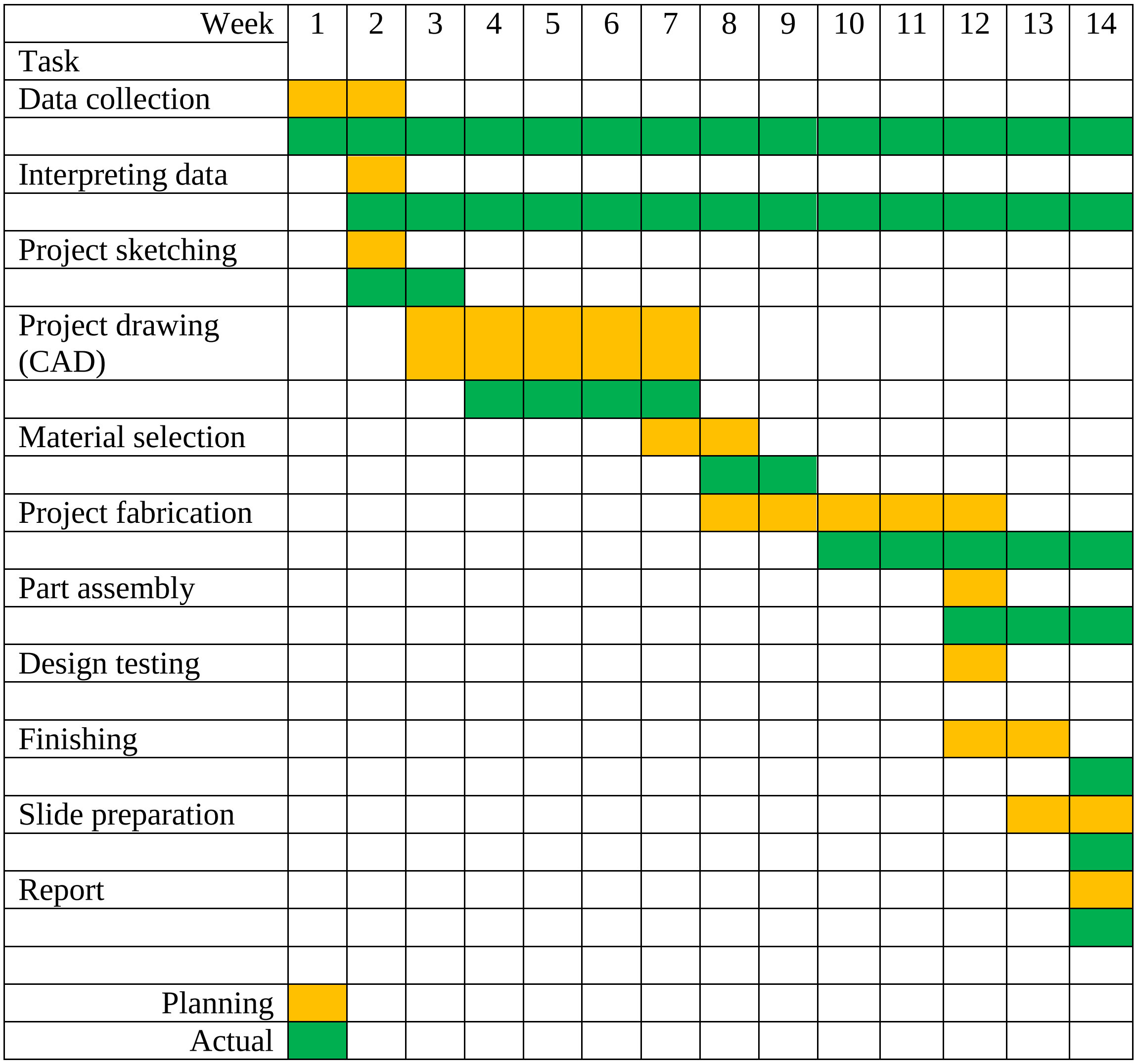



**Figure 1.2: Gantt Chart**

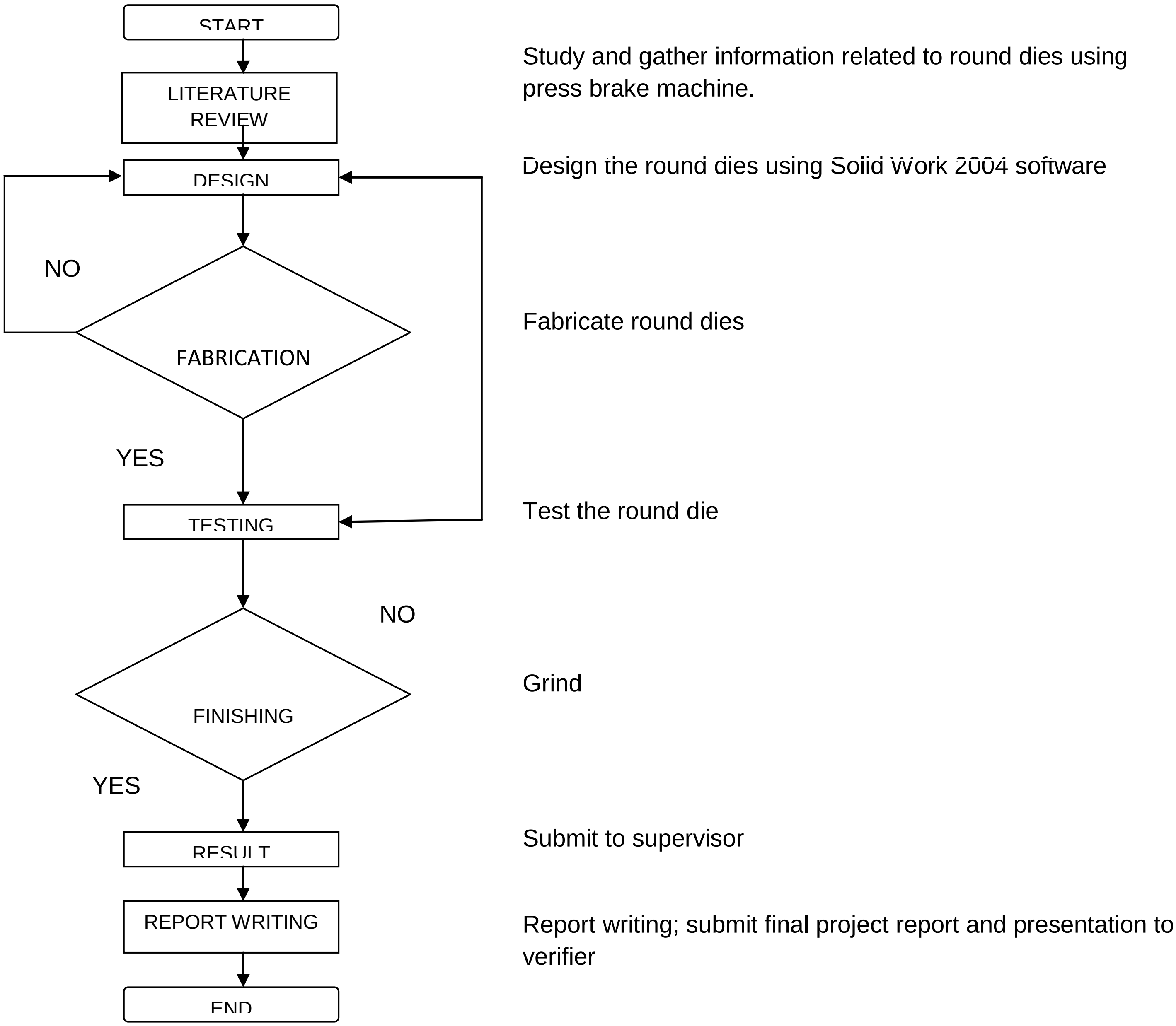



**Figure 1.3: Flow Chart**

# CHAPTER 2

# LITERATURE REVIEW

## 2.1 Introduction

This chapter starts on reviewing the types of dies that have in the market and also a little bit about the press brake machine.

## 2.2 About press brake machine and several types of die

A machine tool is a machine, typically powered other than by human muscle (e.g., electrically, hydraulically, or via line shaft), used to make manufactured parts (components) in various ways that include cutting or certain other kinds of deformation. All machine tools involve some kind of fundamental constraining and guiding of movement provided by the parts of the machine, such that the relative movement between workpiece and cutting tool (which is called thetoolpath) is controlled or constrained by the machine to at least some extent, rather than being entirely "offhand" or "freehand". Machine tools archetypically perform conventional machining or grinding on metal (that is, metal cutting by shear deformation, producing swarf), but the definition can no longer be limited to those elements, if it ever could, because other processes than machining may apply, and other workpiece materials than metal are common. The precise definition of the term varies among users, as detailed in the "Nomenclature and key concepts" section. It is safe to say that all machine tools are "machines that help people to make things", although not all factory machines are machine tools. A press brake, also known as a brake press or just brake (refer to figure 2.1), is a machine tool for bending sheet and plate material, most commonly sheet metal

Typically, two C-frames form the sides of the press brake, connected to a table at the bottom and on a moveable beam at the top. The bottom tool is mounted on the table with the top tool mounted on the upper beam.


**Figure 2.1: TrumaBend machine**

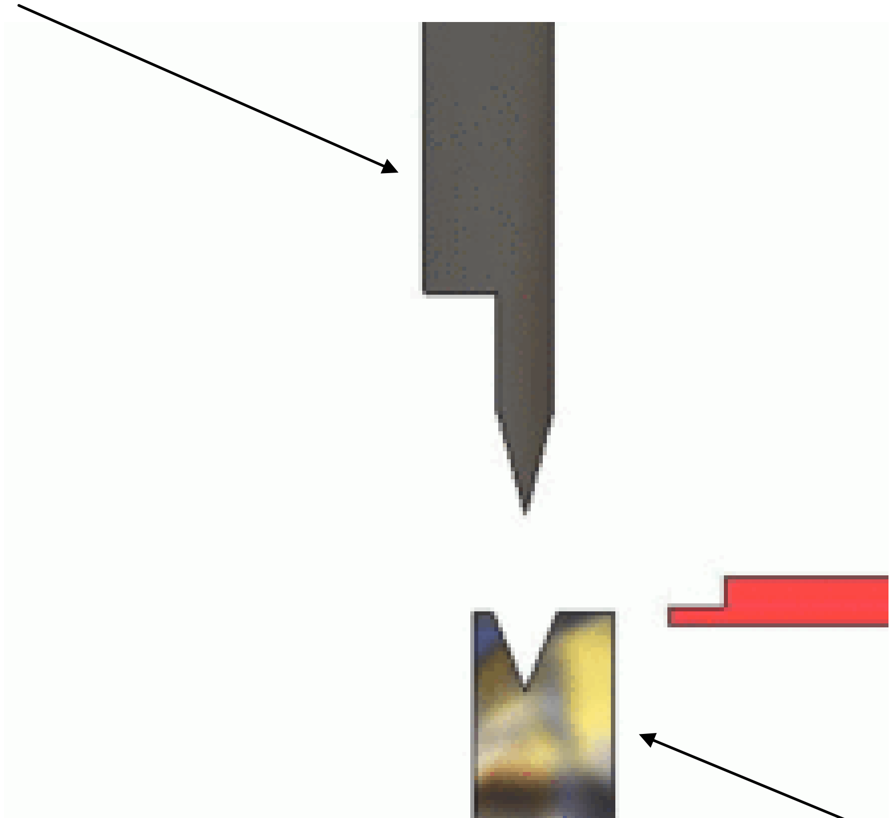
**2.3 Types of brakes**

A brake can be described by basic parameters, such as the force or tonnage and the working length. Additional parameters include the amplitude or stroke, the distance between the frame uprights or side housings, distance to the backgauge, and work height. The upper beam usually operates at a speed ranging from 1 to 15 mm/sec. There are several types of brakes as described by the means of applying force: mechanical, pneumatic, hydraulic, and servo-electric. In a mechanical press, energy is added to a flywheel with an electric motor. A clutch engages the flywheel to power a crank mechanism that moves the ram vertically. Accuracy and speed are two advantages of the mechanical press. Hydraulic presses operate by means of two synchronized hydraulic cylinders on the C-frames moving the upper beam. Servo-electric brakes use a servo-motor to drive a ballscrew or belt drive to exert tonnage on the ram. Pneumatic presses utilize air pressure to develop tonnage on the ram. Until the 1950s, mechanical brakes dominated the world market. The advent of better hydraulics and computer controls have led to hydraulic machines being the most popular.

Pneumatic and servo-electric machines are typically used in lower tonnage applications. Hydraulic brakes produce accurate high quality products are reliable, use little energy and are safer because, unlike flywheel-driven presses, the motion of the ram can be easily stopped at any time in response to a safety device i.e. a light curtain. Recent improvements are mainly in the control and a device called a backgauge. A back gauge is a device that can be used to accurately position a piece of metal so that the brake puts the bend in the correct place. Furthermore the backgauge can be programmed to move between bends to repeatedly make complex parts. Early brakes relied on the tooling to determine the bend angle of the bend(refer figure 2.2). The animation to the right shows the operation of the backgauge, setting the distance from the edge of the material or previous bend to the center of the die.

Press brakes often include multi-axis computer-controlled backgauges. Optical sensors allow operators to make adjustments during the bending process. These sensors send real-time data about the bending angle in the bend cycle to machine controls that adjust process parameters.

a) Punch



**c)** material

**Figure 2.2: Bend Process**

**b)** V-dies

**2.4 Types of dies**

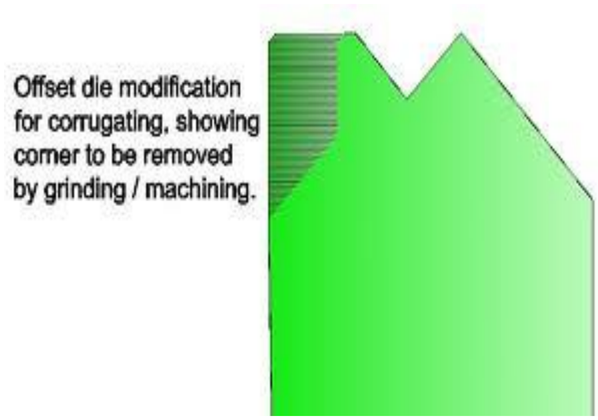
Table 2.4 shows several types of die that have in industry and figure 2.5 shows typical types of V-dies.

(Table 2.4: Types of die)

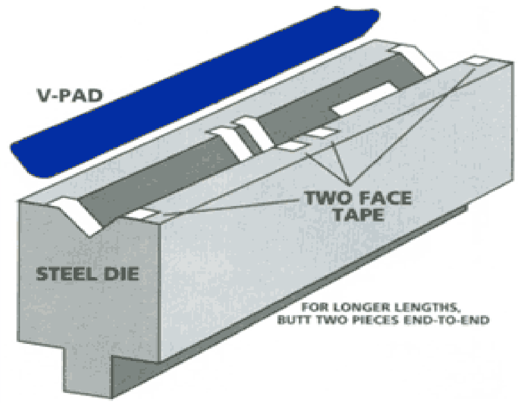
| Types of die | Description |
|---|---|
| V-dies | most common type of die. The bottom dies can be made with different-sized die openings to handle a variety of materials and bend angles. |
| Rotary bending dies | a cylindrical shape with an 88-degree V-notch cut along its axis is seated in the "saddle" of the punch.The die is an anvil over which the rocker bends the sheet. |
| 90degree dies | largely used for bottoming operations. The die opening dimension depends on material thickness. |
| Acute angle (air-bending) dies | used in air bending, these can actually be used to produce acute, 90 degree, and obtuse angles by varying how deeply the punch enters the die by adjusting the ram. |
| Gooseneck (return-flanging) dies | The punch is designed to allow for clearance of already formed flanges |
| Offset dies | a combination punch and die set that bends two angles in one stroke to produce a Z shape. |
| Hemming dies | two-stage dies combining an acute angle die with a flattening tool. |
| Seaming dies | There are a number of ways to build dies to produce seams in sheets and tubes. |
| Radius dies | radiused bend can be produced by a rounded punch. |

| | |
|---|---|
| | The bottom die may be a V-die or may include a spring pad or rubber pad to form the bottom of the die. |
| Beading dies | A bead or a "stopped rib" may be a feature that stiffens the resulting part. The punch has a rounded head with flat shoulders on each side of the bead. The bottom die is the inverse of the punch. |
| Curling dies | The die forms a curled or coiled edge on the sheet. |
| Tube- and pipe-forming dies | a first operation bends the edges of the sheet to make the piece roll up. Then a die similar to a curling die causes the tube to be formed. Larger tubes are formed over a mandrel. |
| Four-way die blocks | A single die block may have a V machined into each of four sides for ease of changeover of small jobs. |
| U-bend dies | with a rounded bottom. Springback may be a problem and a means may need to be provided for countering it. |
| Channel-forming dies | A punch can be pressed into a die to form two angles at the bottom of the sheet, forming an angular channel. |
| Box-forming dies | While a box may be formed by simple angle bends on each side, the different side lengths of a rectangular box must be accommodated by building the punch in sections. The punch also needs to be high enough to accommodate the height of the resulting box's sides. |
| Corrugating dies | Such dies have a wavy surface and may involve spring-loaded punch elements. |

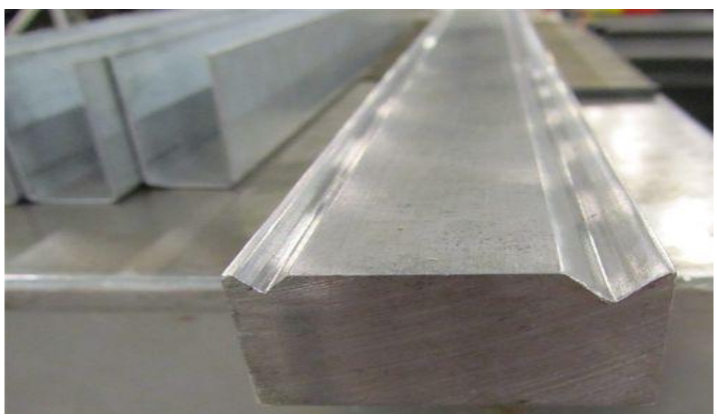
## 2.5 Typical types of die




Corrugating die




V dies



Double V-dies

**Figure 2.5: Typical types of V-dies**

The radius die is use to produced a radius bend by a rounded punch. The bottom die may be a V-die or may include a spring pad or rubber pad to form the bottom of the die. Material that been use is mild steel. Mild steel have been choose because it is hard but easily shaped. Conventional milling machine and EDM wire cut machine have been use to produce this dies. Figure 2.1 shows typical types of die.

# CHAPTER 3

# METHODOLOGY

## 3.1 Introduction

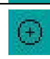
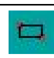
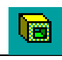
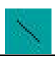
The project starts with literature review and research about the title. This is consist a review of the current design and gather the other information about the current design. These tasks have been done through research on the internet, books and others sources.

After gathering all the relevant information, the project undergoes design in Solid Work. In this step, from the information gather from the review is use to make a design The design is transfer to solid modelling and engineering drawing using SolidWorks program.

## 3.2 Design Process

In using Solid Work software, there are many function of each icon to draw the design of the die (refer figure 3.2). Each icon have it function to draw every part of the drawing. For figure 3.1 and figure 3.2, only the icon like in the table 3.1 are use to make every part of the drawing. (Detail drawing and dimension as attached in Appendix A.)

**Table 3.1: Icon in solidwork to draw and design the round die**

| No | Icon | Function |
|---|---|---|
| 1 |  | To make fillet |
| 2 |  | To make chamfer |
| 3 |  | To draw circle |
| 4 |  | To draw rectangle |
| 5 |  | To extruded cut |
| 6 |  | To extruded |
| 7 |  | To draw line |

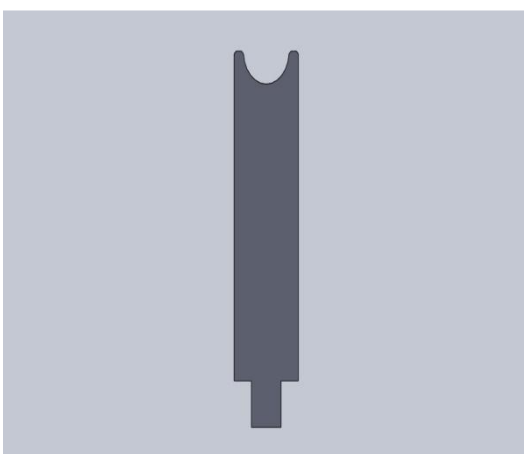


**Figure 3.1: Front view of round die**

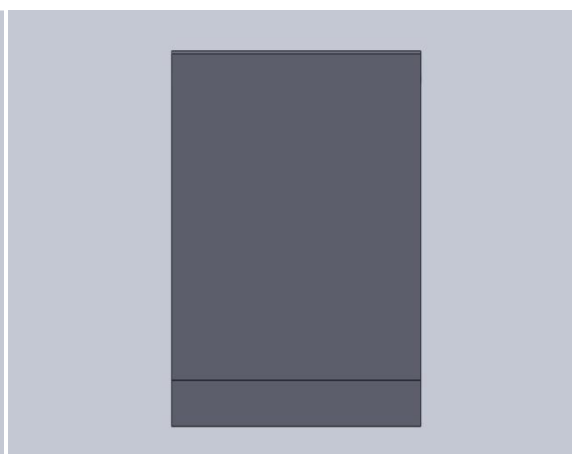


**Figure 3.2 : Side view of round die**

### 3.3 Fabrication Process

After all the drawing finished, the drawing was used as a reference for the next process which is fabrication process. This process is consists fabricate the parts that have design before by following all the dimension using various type of manufacturing process. The manufacturing process included in the process is cutting, facing, boring and the others. During the fabrication process, if there is something wrong occur such as not balance dimension so the process stop and go back to previous step, check the design back.

During the fabrication process are need to use a certain machine like conventional milling machine (figure 3.3), edm wire cut machine (figure 3.4) and other. There are the certain basic in using that machine, like milling machine. The x-axis, y-axis, and z-axis. In the facing process after the work piece are clamped, just need to move the ‘mata alat’ to x-axis or y-axis or z-axis.

After that is the testing process. In this process is just test the project can be use and same with the current function. Due to some problem that will discuss later in other chapter, the testing only can be made on several aspect only. During the testing, if problem occur such as malfunction, the process step back to previous process, which is fabrication.

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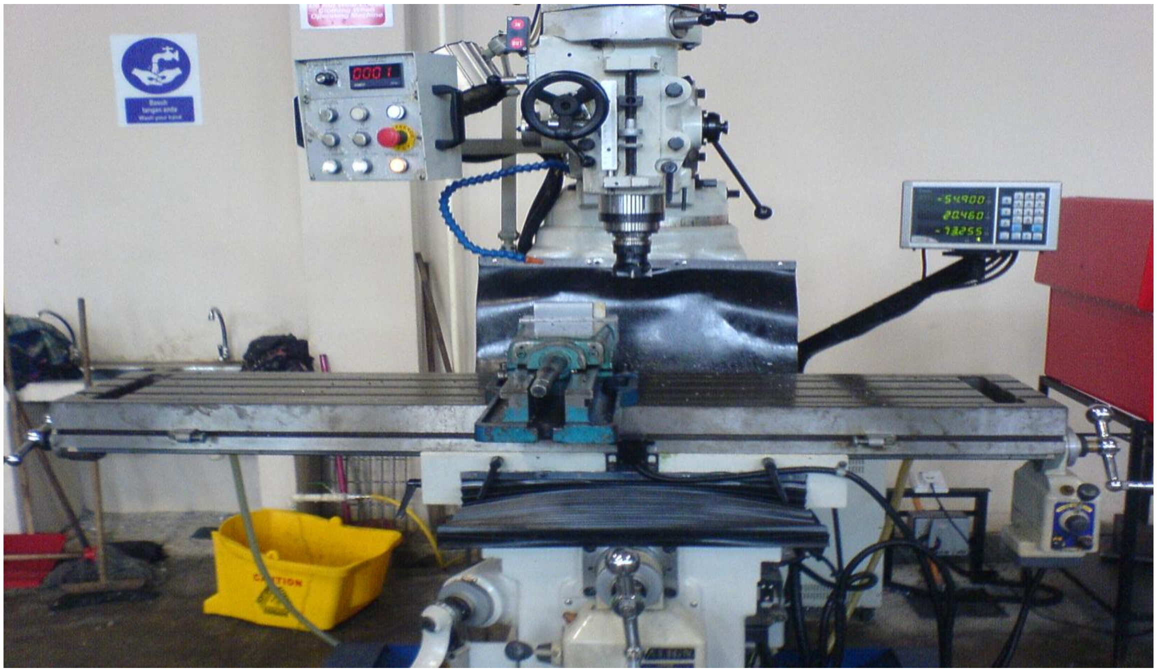


**Figure 3.3: Conventional Milling Machine**

**Figure 3.4: EDM Wirecut Machine**

# CHAPTER 4

# RESULTS AND DISCUSSION

## 4.1 Introduction

After designing in SolidWork software is a fabrication process. These processes is about using the material Selection and make the product base on the design and by followed the design dimension. Many process will be use in this fabrication process, like cutting, facing, boring and other. Fabrication process is difference from manufacturing process in term of production quantity. Fabrication process is a process to make only one product rather then manufacturing process that focus to large scale production. In the project fabrication process needed to make the round dies, fabrication process was used at the whole system production. This was include by part fabrication until assembly to others component.

**4.2 Processes**

In fabricating process, several process have been used to fabricate the round dies, which is;

-using the conversional milling machine

- Cutting unwanted materials as roughing process
- Facing is to face critical dimension area

-using the edm wirecut machine to cut complex shape in the drawing

- This complex shape to make the upper part of round die

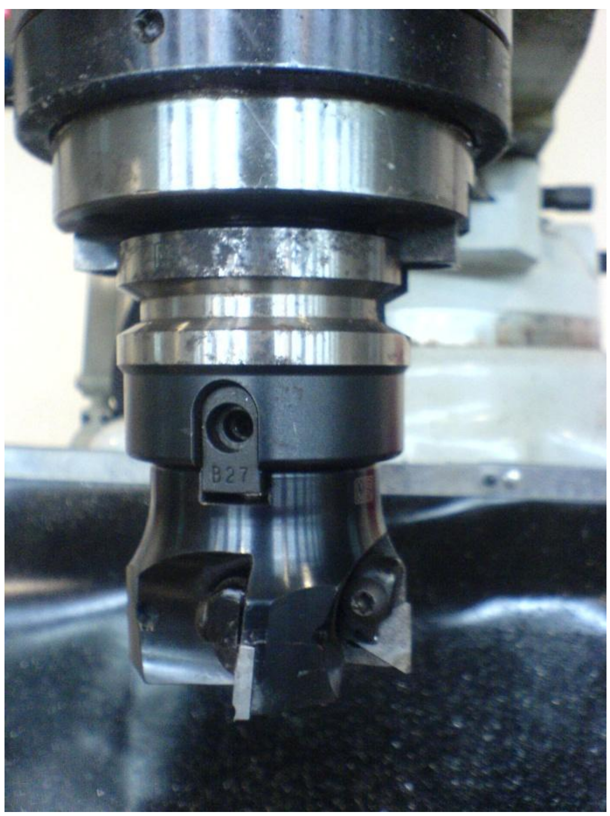



**Figure 4.1: Face mill**

### 4.3 Step by step of the Process

The fabrication process is start with measuring and marking the raw material into the dimension needed. Then when done the marking process, cut the materials using bend saw. All the measuring and marking process is done by using steel ruler, measuring tape, steel marker and vernier calliper.

After cutting process is done, the material goes to next process, fabricate. First part is a base. By using conversional milling machine, the first step is clamp the work piece and start with facing process. The facing process is using by face mill and the dimension is follow on drawing. When the facing process is done, the next process is cutting. In this process is need to use an edge finder and end mill. The dimension of this work piece is 120mm x 30mm. and the thickness is 50mm.

The part that should be cut by the end mill is the 20mm base by using conversional milling machine. The original length is 30 mm so I have to reduce it to 13mm according to the drawing. Make a slot with dimension 8.5mm each.

After done doing that, arrange back the tool that have been use to the original position. Make sure the machine have been clean neatly and being off before go out.

The next step is the process for making the round die using edm wire cut. Firstly convert the drawing into dxf format. The edm wirecut only can read dxf format which is mastercam format. Then save the drawing in the disket to key in it to the machine. Then the machine will read the drawing and the coding will appear on its own. Then setting the workpiece into the machine, clamp the workpiece tide and neatly. Then with the help of the engineer assistant, run the program and the machine will cut the workpiece just same as the drawing that have been key in the machine.(refer figure 4.2 and figure 4.3)

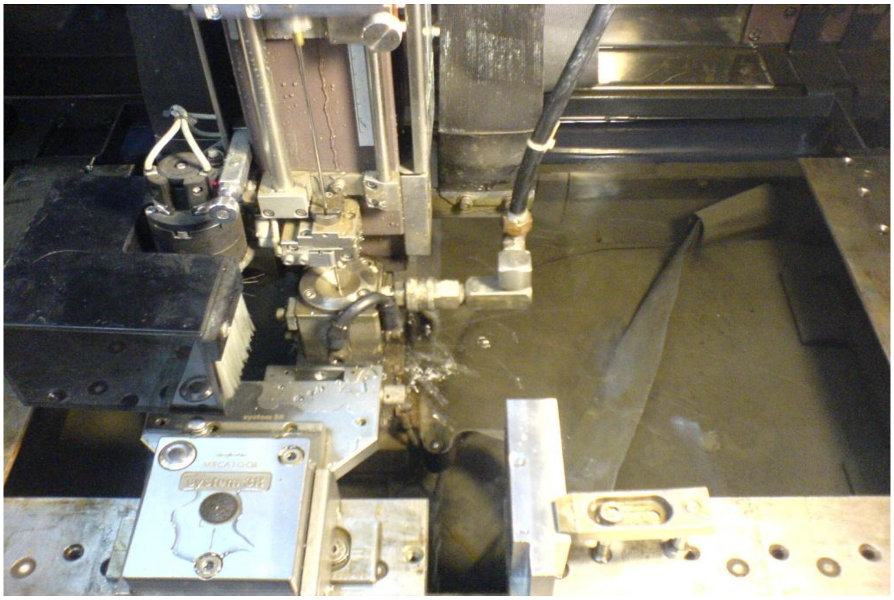
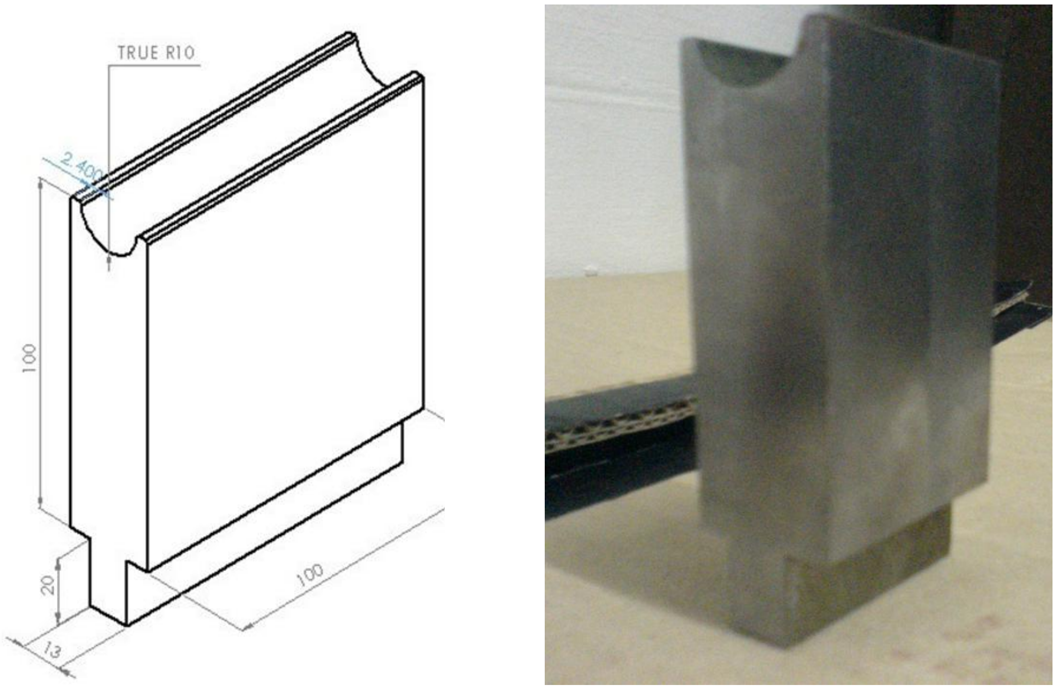


**Figure 4.2: EDM wirecut cutting process 1**

**Figure 4.3: EDM wirecut cutting process 2**

## 4.4 Result after fabrication




a) Design b) Product

**Figure 4.4: Design and The product of the round die**

**Table 4.4: Dimension comparison between actual dimension and last dimension**

| **Design Dimension** | **Product Dimension** |
|---|---|
| 100mm | 100mm |
| 100mm | 50mm |
| 13mm | 13mm |
| R10mm | R10mm |
| 20mm | 19mm |
| 2.4mm | 2.4mm |
| 30mm | 29mm |

The product have been success to be produce. Unfortunately, some of the dimension cannot be acceed. For the width of the die, it should be 100mm, but the material that have only 50mm. Some of the dimension also are not equal to the design according to the pograming error from the machine. Somehow, all the dimension are not fixed except the radius 10mm the base of the die which is 13mm.

# CHAPTER 5

# CONCLUSION

This chapter is about problems the project encounter before, during and after the project. This chapter also will discuss about the conclusion of the project. Problem that will be discussed here is the entire problem encountered in every task in the project.

For the conclusion the project is achieves the objectives. The round dies were drawn using the SolidWorks software. The fabrication of the part are important to ensure dimension accuracy to avoid a problem in the assembly process. Fabricate process is using milling and edm wirecut machine.The last step in scope of work is testing. In this scope we just need to test the round dies using the bend machine.

The drawing and fabrication process is complete. To avoid from rust, the parts was cover by the oil. When has a little changes in the dimension, it can effect when want to assemble the die to the machine, this is also a problem to change all the dimension. To make sure there are no problem in assembling process.

For the future planning for the round dies is to change a little bit the design so it can be more easy to change the dies. For example like my second concept, make the dies can be separate so that when we want to use v dies or any dies, just place the head of the dies.

## REFERENCES

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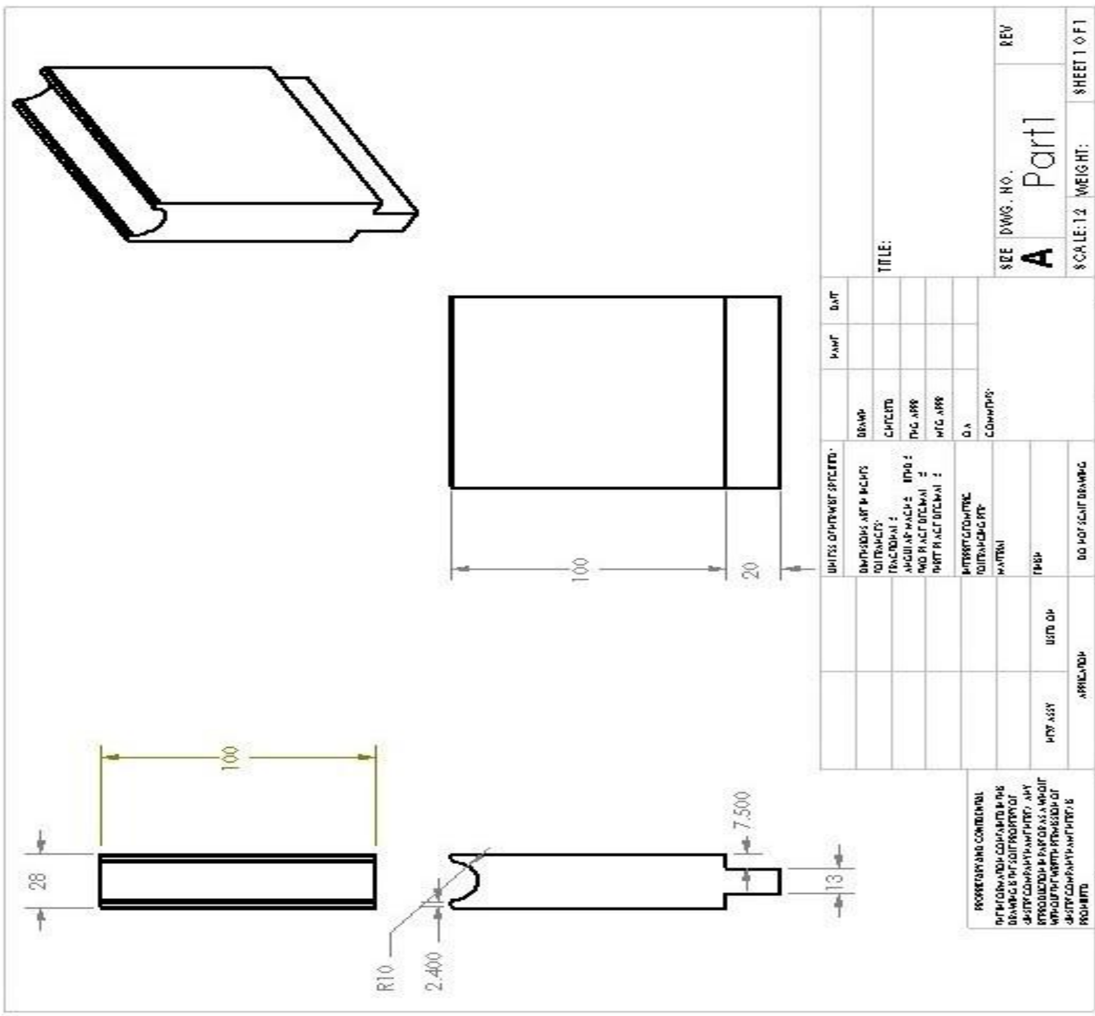
2. http://en.wikipedia.org/wiki/Brake_(sheet_metal_bending)

3. http://www.pipebendingmachineindia.com/product.html

4. http://www.rkbrakedies.com/American%20Style%20Radius%20Die%20Sets.htm

# APPENDIX A



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13
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Part1
REV
SCALE: 1:2
WEIGHT:
SHEET 1 OF 1